Mercury Contamination in Sediment of the Lake Erie Basin

Chris Marvin, Scott Painter and Alice Dove

Environment Canada

Ron Rossmann

USEPA

Environment Canada Environnement Canada

Collaborators

- ***Ontario Ministry of the Environment:*** **Eric Reiner, Terry Kolic, Karen MacPherson**
- ***Environment Canada:*** **Mehran Alaee, Murray Charlton, Derek Muir**
- ***Department of Fisheries and Oceans*****: Gregg Tomy, Gary Stern**
- ***USGS*****: Donna Myers, Dan Button**
- ***USEPA*****: Ron Rossmann**
- ***Ohio EPA*****: John Estenik**

Why Seds???

- Primary sink for contaminants in the Great Lakes
- Primary source
- Contamination of seds reflective of compounds responsible for environmental impairment and fish consumption advisories
- Time-integrated contaminant burden
- Availability of historical data

Years for Whole-Lake Data Availability

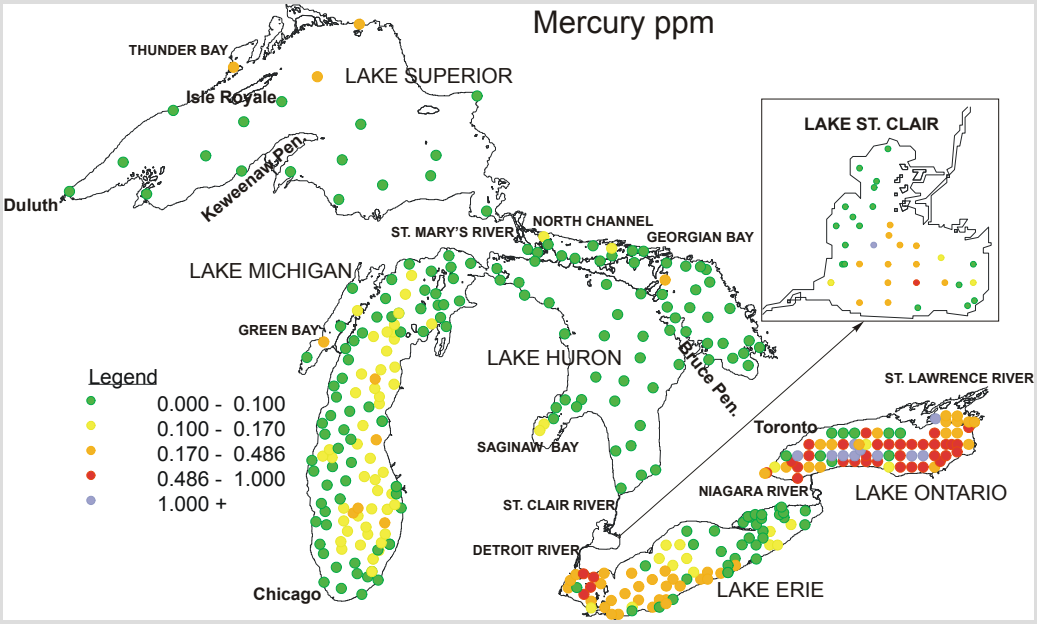
Historic Data

- Lake Ontario 1968
- Lake Huron 1969
- Lake St. Clair 1970
- Lake Erie 1971
- Lake Superior 1973
- Lake Michigan 1969-1970
- Lake Michigan 1975

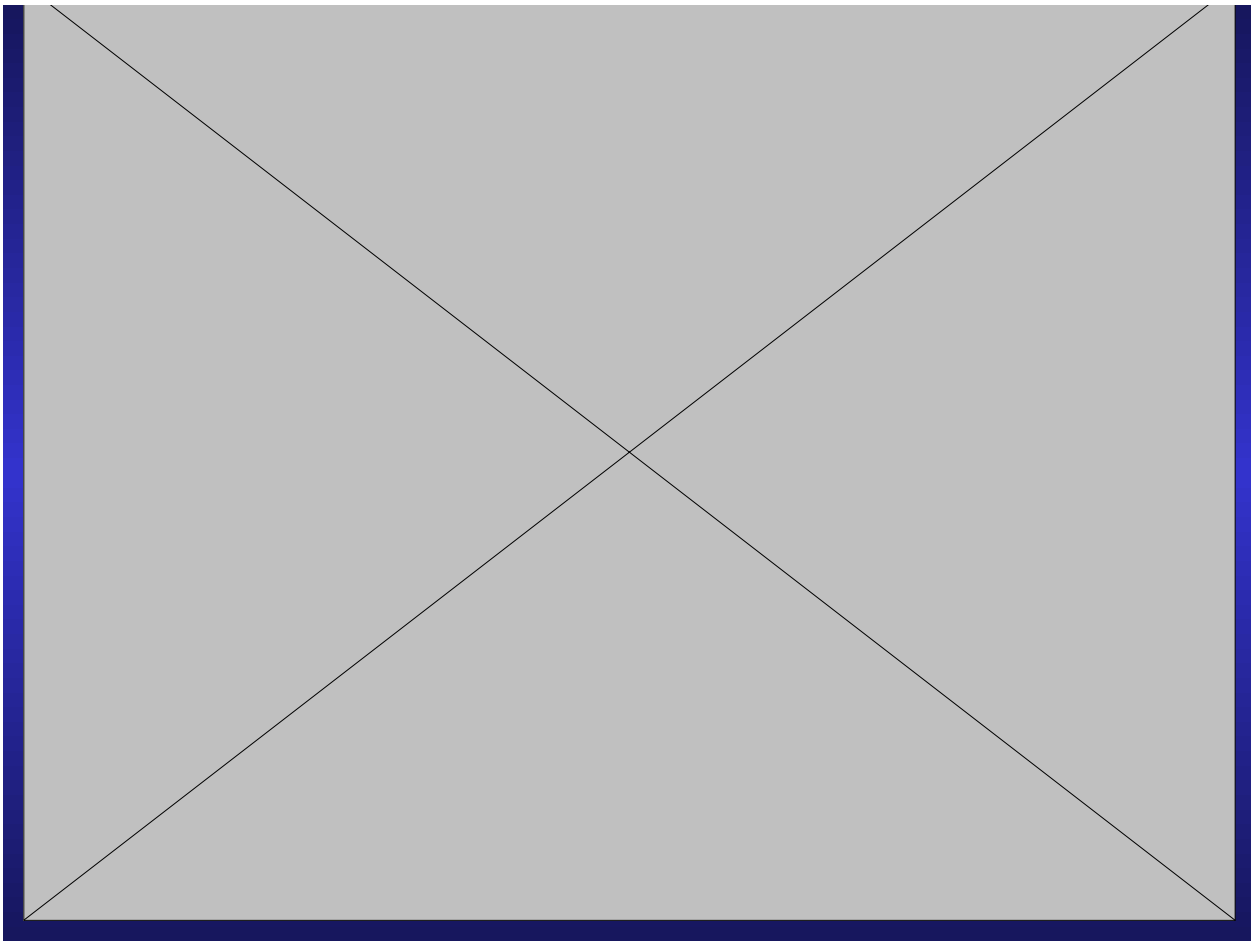
Most Recent Data

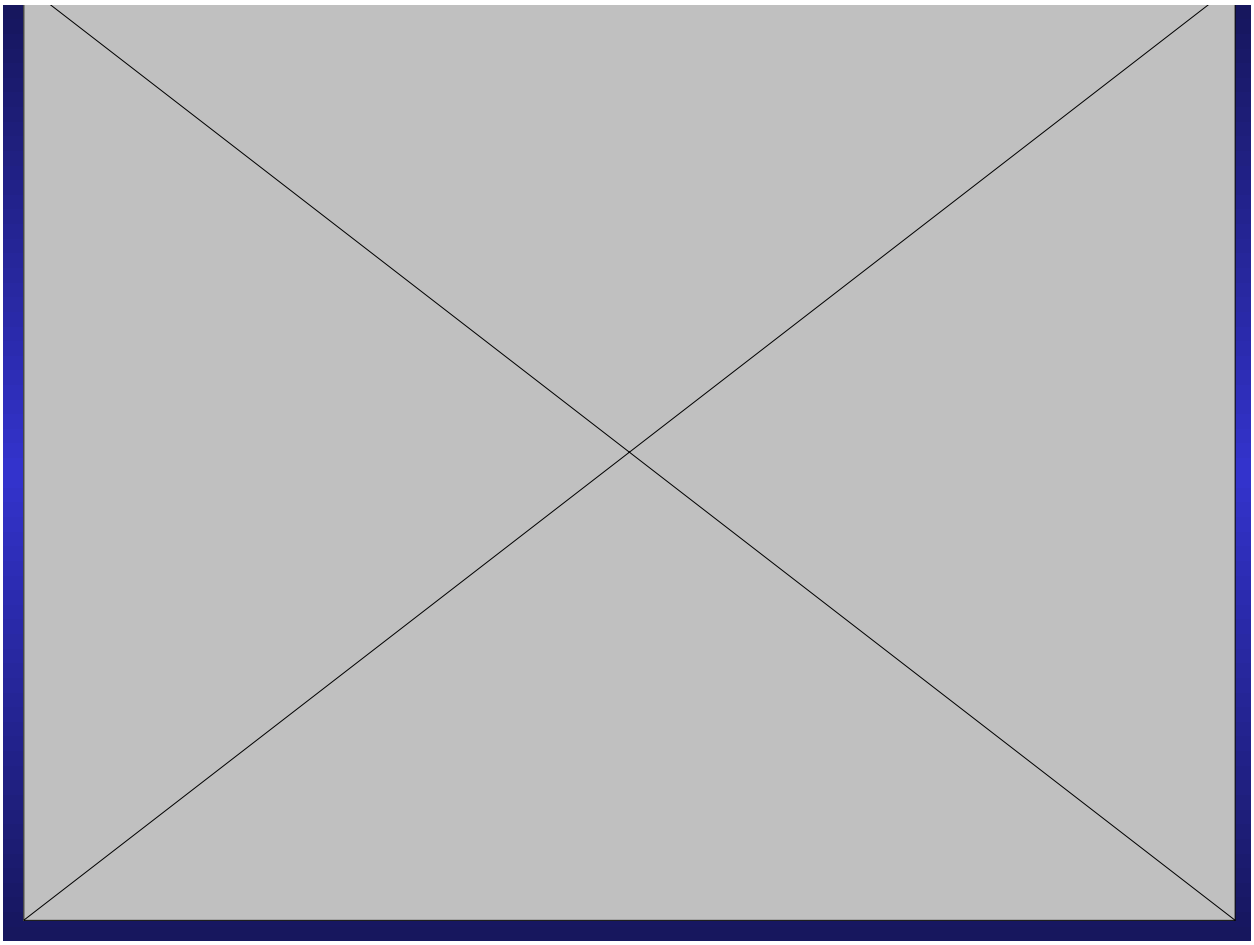
- Lake Ontario 1998
- Lake Huron 2002
- Lake St. Clair 2000
- Lake Erie 1997-1998
- Lake Superior 2000
- Lake Michigan 1994-1996

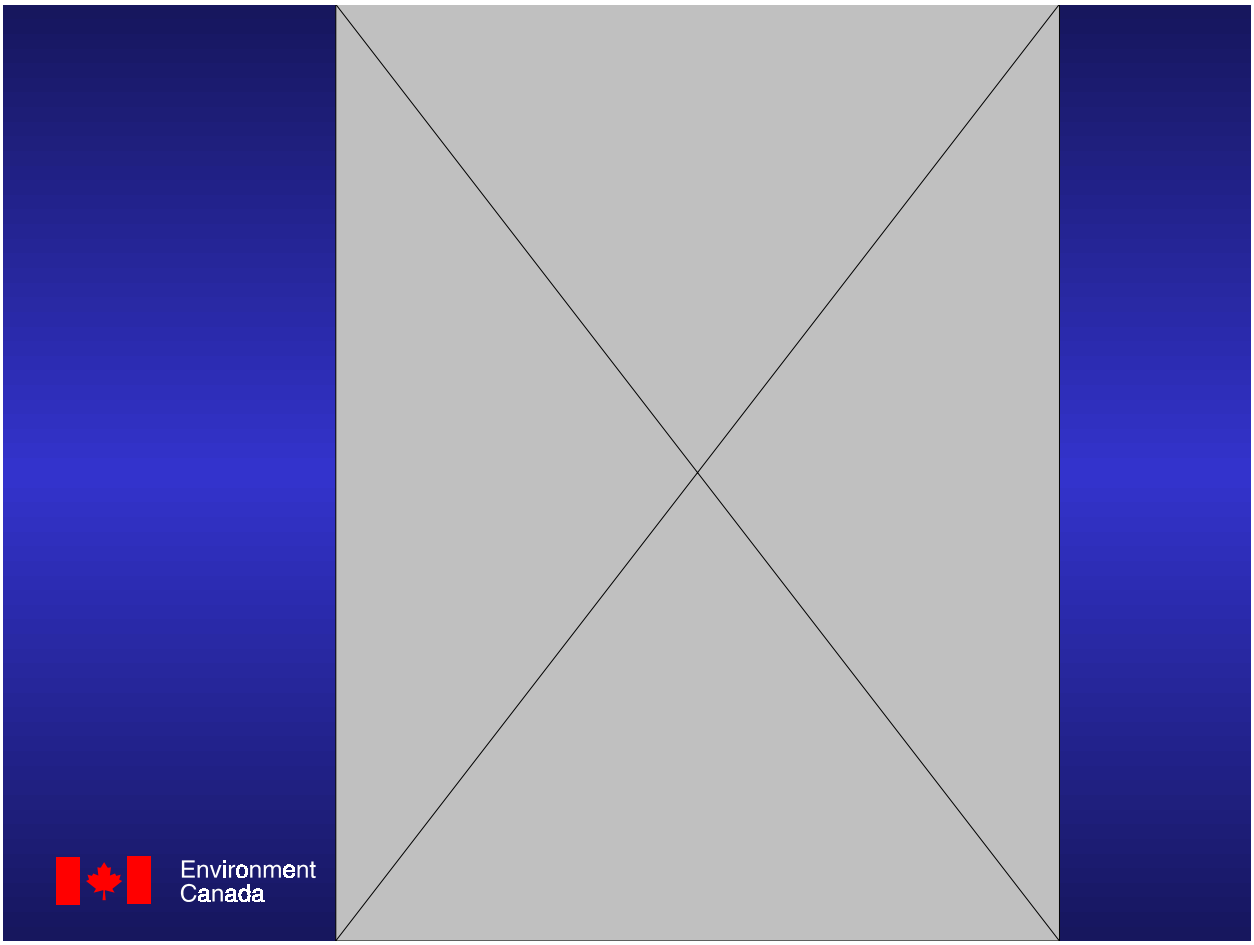
Environment Canada Environnement Canada

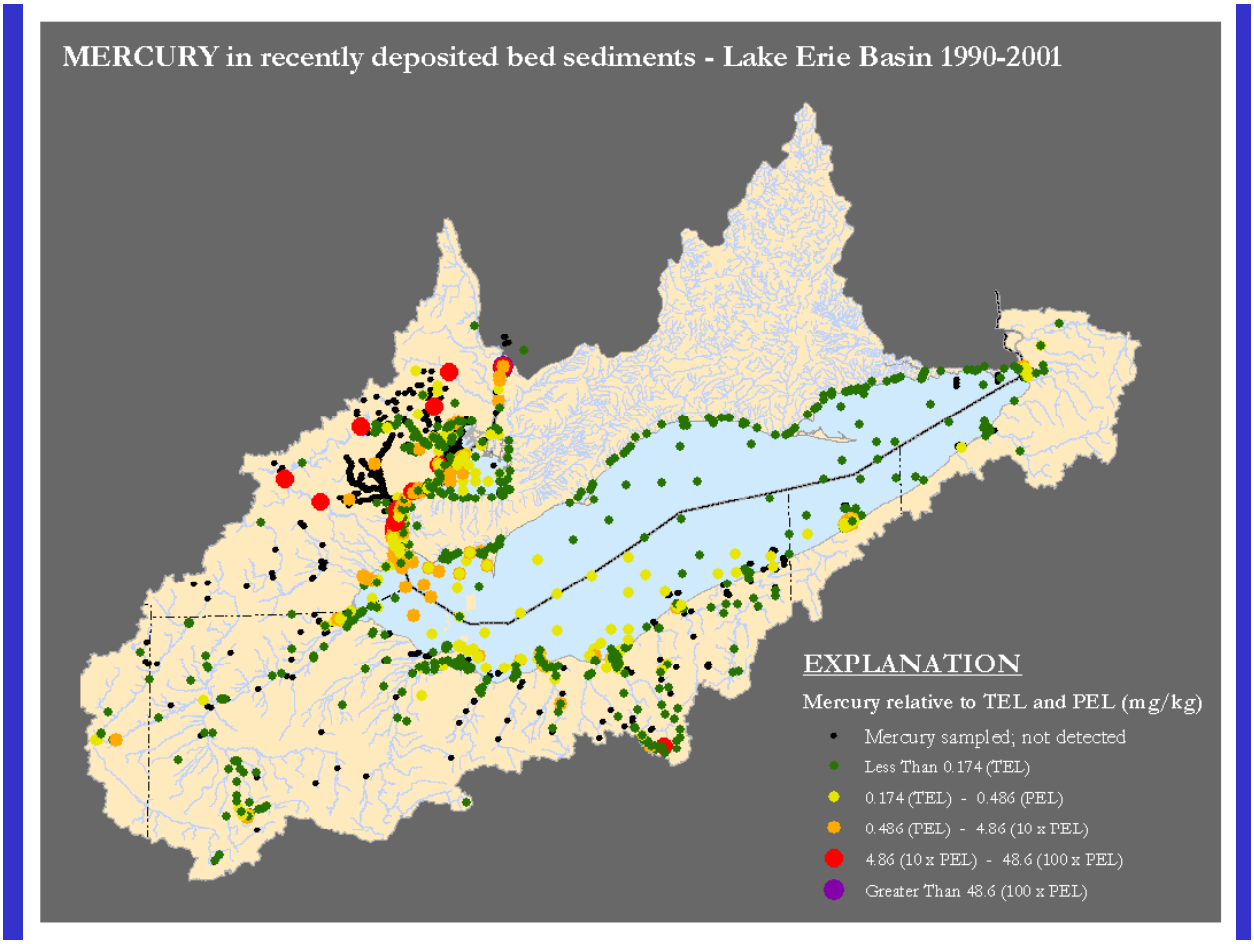


Environment Canada Environnement Canada

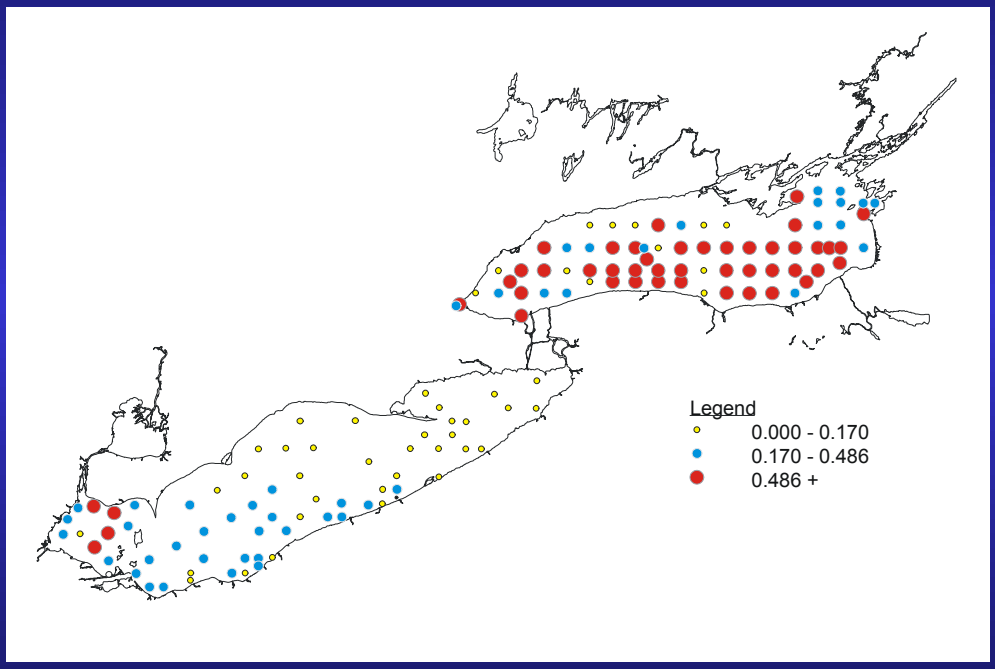





Environment
Canada


MERCURY in recently deposited bed sediments - Lake Erie Basin 1990-2001
EXPLANATION
Mercury relative to TEL and PEL (mg/kg)
Mercury sampled; not detected
Less Than 0.174 (TEL)
0.174 (TEL) - 0.486 (PEL)
0.486 (PEL) - 4.86 (10 x PEL)
4.86 (10 x PEL) - 48.6 (100 x PEL)
Greater Than 48.6 (100 x PEL)

Comparison of Mercury in Lakes Erie and Ontario



Environment Canada Environnement Canada

Inter-Lake Comparisons

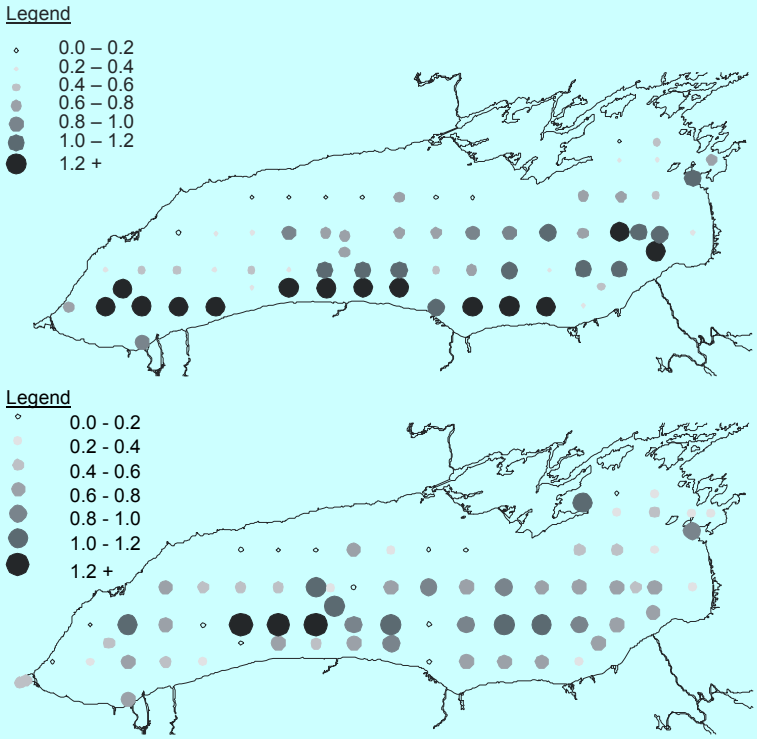
- Total mercury concentrations in the most recently collected surficial sediments increase in the order Lake Huron (43 ppb) < Lake Michigan (78 ppb, excluding Green Bay) < Lake Superior (88 ppb) < Lake Erie (190 ppb) < Lake St. Clair (200 ppb) < Green Bay (360 ppb) < Lake Ontario (600 ppb).

Spatial Distribution of Mercury

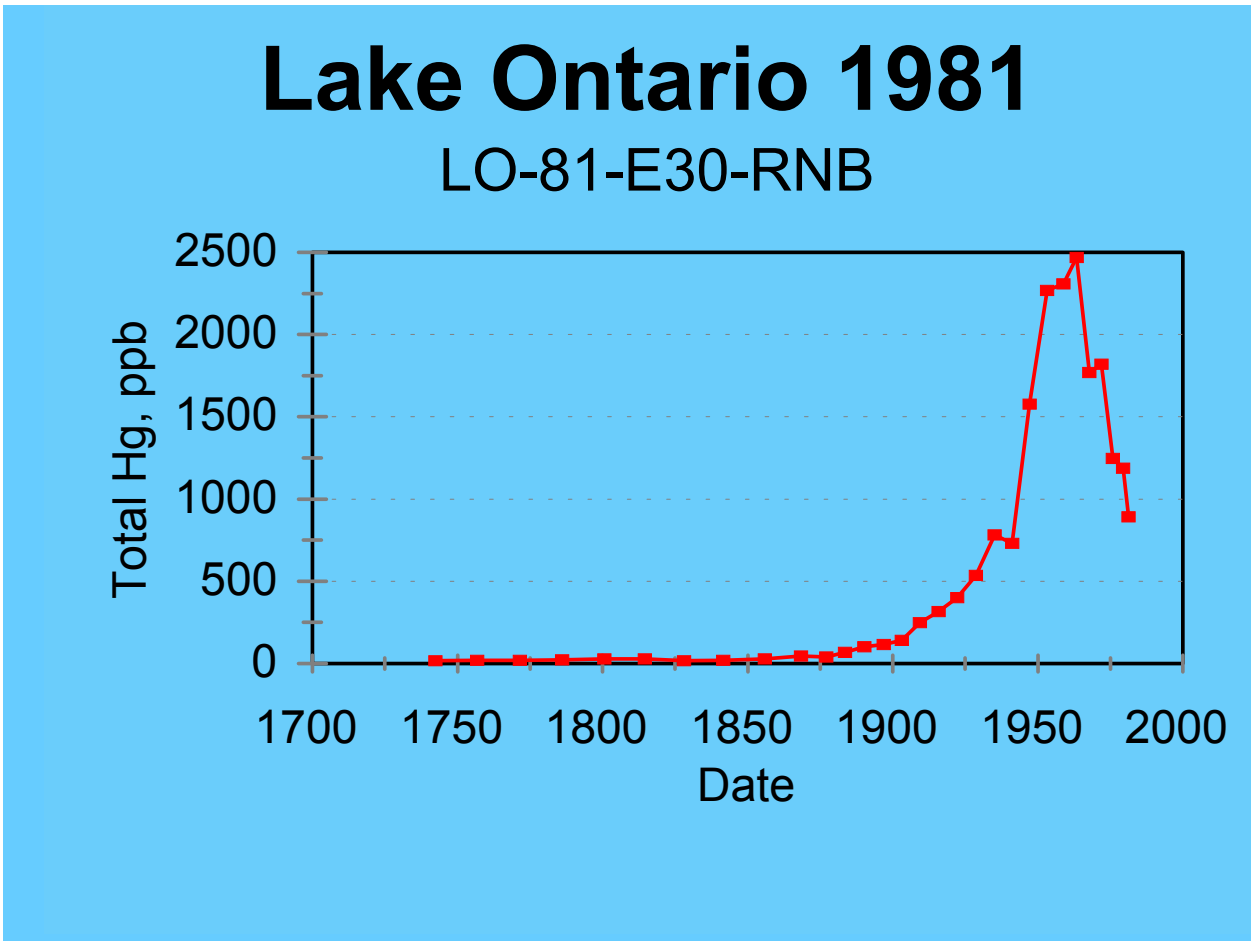
- Lakes Huron, Michigan (excluding Green Bay), and Superior surficial sediments are the least contaminated with mercury.
- Lake Ontario, Green Bay, and western Lake Erie surficial sediments are the most contaminated with mercury.

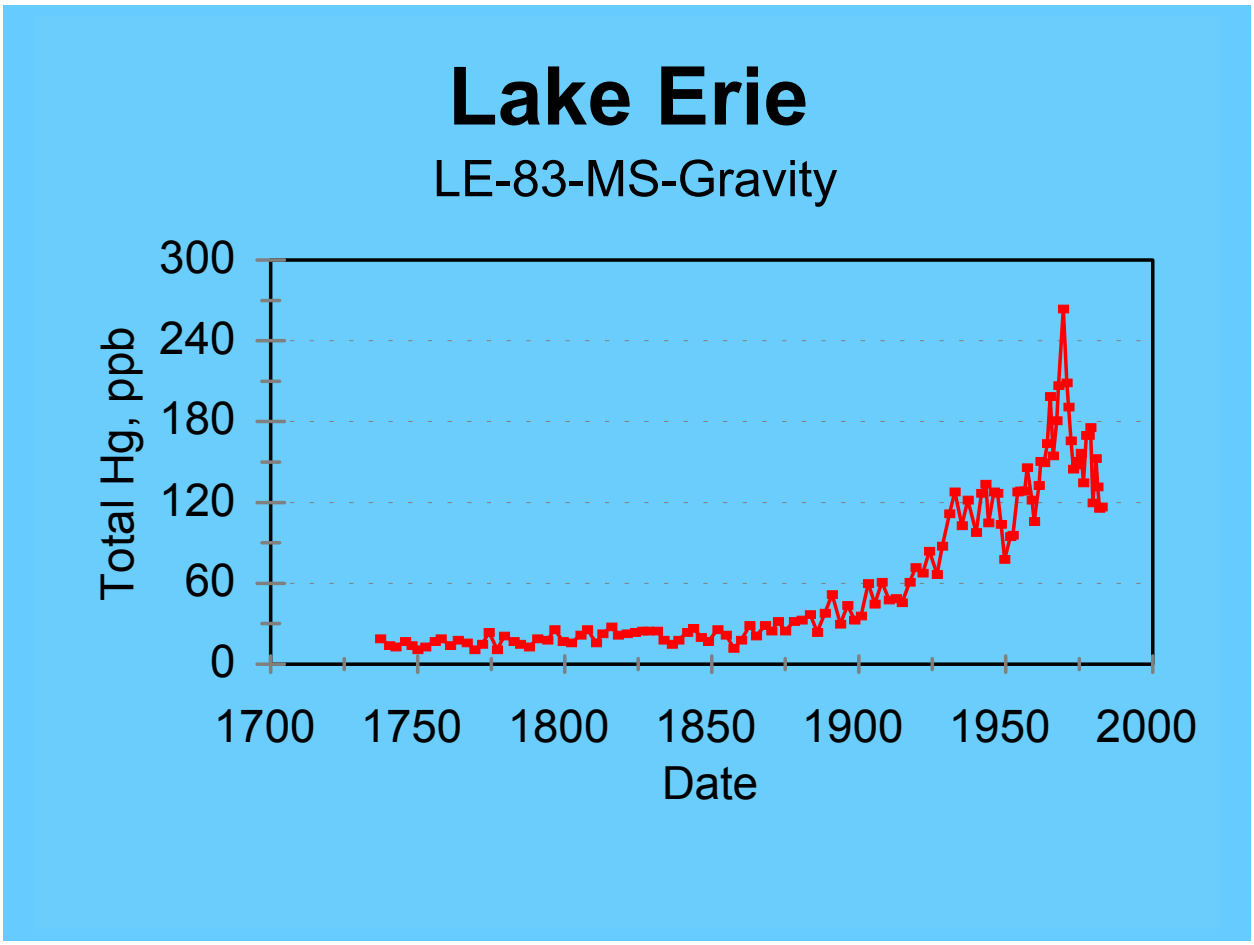
Environment Canada Environnement Canada

Comparison of Mercury in Lake Ontario in 1968 vs. 1998



Environment Canada Environnement Canada


Lake Ontario 1981
LO-81-E30-RNB
Total Hg, ppb
2500
2000
1500
1000
500
0
1700
1750
1800
1850
1900
1950
2000
Date


Lake Erie
LE-83-MS-Gravity
Total Hg, ppb
300
240
180
120
60
0
1700
1750
1800
1850
1900
1950
2000
Date

Sediment Cores

- Sediment cores confirm total mercury decline in surficial sediments.
- Sediments in all of the Great Lakes were impacted in the mid- to late 1800s, increasing to maximum levels of contamination in the mid 1950s to late 1960s, followed by declines to current levels

Environment Canada Environnement Canada

Status of Mercury in the Great Lakes Basin

- Significant decreases in mercury contamination in surficial sediments over the period 1972 – 1998.
- Sediments in some areas still exceed guideline values for the protection of aquatic biota (Canadian PEL = 0.486 ppm), particularly in Lake Ontario, western Lake Erie, Green Bay and Lake St. Clair

Environment Canada Environnement Canada

Status of Mercury, cont.

- Need for source phaseout; elimination of industrial and commercial processes and products that unnecessarily use mercury.
- Past practices have resulted in both widespread elevated levels of mercury, as well as locally contaminated sites. Occurrences of fish consumption advisories are a legacy of geographically dispersed sediment contamination in the basin.

Environment Canada Environnement Canada

Status of Mercury, cont.

- Deep burial of contaminated sediments in depostional environments such as the Great Lakes is our only management option.
- Localized contaminated sites can be sources that result in offsite migration of mercury
- Remediation of local “legacy” sources results in progress towards substantive reductions in mercury in the environment.

Environment Canada Environnement Canada